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ABSTRACT

This report, the first volume in a three volume set, summarizes the results of a study performed by the DELTA (Developing European Learning through Technological Advance) Unit in parallel with the projects underway in the research and development Exploratory Action. The report identifies the key issues, associated requirements and options, and potential actions to be taken. Chapters include the following: (1) Challenges and Opportunities, which covers training in a highly technological environment in Europe; (2) Shaping of Change--Potential Market Demand and Problems of Supply; (3) Learning Technology Pedagogics, which covers tutoring, process management, modelling the learner or trainee, didactic strategies, exploratory scenarios, collaborative learning, psychological and motivational factors, learning technology cost and effectiveness; (4) Learning Technologies, which covers portability, interoperability, and standardization; learning configurations; learning facilities; design and production systems; communications; information environments; training servers; and applications; (5) Policy and Planning for Implementation, which covers the regulatory framework, norms and standards, editorial scenarios, technological scenarios, telecommunications scenarios, infrastructures, and evolutionary strategies. (DB)

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R+D in Information and Communication based learning technology

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IMPACT ASSESSMENT & FORECASTS OF INFORMATION AND COMMUNICATIONS TECHNOLOGIES APPLIED TO FLEXIBLE AND DISTANCE LEARNING

- VOLUME I: EXECUTIVE SUMMARY -

Analysis of key issues for the orientation of the work of sector actors in the framework of DELTA

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VOLUME I - EXECUTIVE SUMMARY

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PREFACE

This volume of the Impact Assessment and Forecasts Report on Information and Telecommunications Technology Applied to Education and Training forms part of the review process within the DELTA framework, carried out in order to assess the achievements of the programme in a broader context and to point the way forward to the future developments needed in the domain of Advanced Learning Technology at a European level. It identifies the key issues, associated requirements and options and potential actions to be taken. Thus it aims at orientating the work of the sector actors in the framework of DELTA.

The other volumes of the report are:

- Volume II: Main Report and Issues Analyses.

- Volume III: Glossary and Annex on State of the Art of Advanced Learning technologies.

EXECUTIVE SUMMARY

1. CHALLENGES AND OPPORTUNITIES

1.1. Training in a Highly Technological Environment

The quality of human resource development is now widely recognised as a key factor for Europe's future competitiveness - in fact it could be the essential factor which gives European organisations a competitive edge over major rivals. At present there are no structures for ensuring that the level of training needed in order to maximise human resources will be available to industry and commerce.

Europe's changing demographic profile is raising the demand for mid-career training. From now until the turn of the century there will be a dramatic decrease in the school-leaving age-group as a proportion of the total population. The annual excess of births over deaths dropped from 8 per 1000 to 2 per 1000 people, between 1960 and 1988, leaving a proportionally reduced youth population entering the labour market between now and the early 21st century. With fewer entrants to the labour market, industry and commerce will have to place more emphasis on the development of their existing human resources. At the same time, competition for highly qualified staff has taken on a new international dimension. European industry has to compete to retain its best employees, placing even greater responsibility on human resource development.

It has been calculated that the average employee now requires four periods of substantial retraining during his or her career. In some sectors of industry the level of innovation is forcing even more dramatic training requirements on to employers and employees.

Rapid innovation in computer and communications technologies has created a dramatic increase in the need for training and retraining. At the same time they provide a possible mechanism for new and innovative forms of training. It should be noted however that training is not a hermetic issue. The changes which are taking place in training and retraining are a product of fundamental changes in the organisation of industrial production, commercial services and international trade. The possibility of a new technological infrastructure for training purposes has therefore to be related to and consistent with the experience of change in the wider economic environment.

The EC economy has experienced, over the past 25 years, a significant realignment of the major sectors of production in the Community's overall gross domestic product. There has been a steady decline in the share of manufacturing and products and an expansion of market and non-market services such as financial services, transport, tourism, distribution, consultancy etc. These sectors are known to have a high 'information' content. However, it is not only in the new service sector that the demand for information and information exchange is increasing. In the manufacturing sector there are significant shifts in the organisation of production provoked by, and now dependent upon, systematic information collation and exchange.

The Small and Medium Sized Enterprise (SME) will grow in importance in key sectors of the European economy. Its growing stature will be based on new forms of production and on new organisational principles, both of which create new training needs.

Underlying these changes is the rapid development of information and telecommunications technology and its associated software. As well as constituting significant industrial sectors in their own right, information and telecommunications technology are creating a new infrastructure through which industrial and commercial organisations will interact with their customer and supplier bases. This infrastructure represents one of the greatest long term investments of the later 20th century.

The impact of this emerging infrastructure on the operations of businesses and public services will be profound and it is essential that the changing style of worklife which it produces is adequately addressed by new forms of training.

1.2. Advanced Learning Technologies - A key to Europe's Future

The factors outlined above are forcing a reappraisal of training and education in Europe and in the process are changing the character of this sector from that of a traditional supplier of services into a newly competitive sector in its own right.

It is important to make a realistic outline appraisal of the likely pace and direction of infrastructure development. The ultimate objective of the DELTA Exploratory Action is to indicate ways in which Europe's training needs can be met by advances in information and telecommunications technology. It is expected that future training materials will be multimedia in character, developing through on-line computer conferencing to videconferencing, satellite and terrestrial broadcasting, and multimedia co-work, using advances in videotext, on-line graphics distribution and stand alone interactive systems such as CD-I, DVI, and CD-Rom.

The development of learner hardware and software (mostly PC based) is expected to be rapid. The market for these in 1988 was some 650 MECU. This is expected to increase to a total in excess of 1200 MECU by the end of 1990. Such a rapid rate of growth reflects the substantial investments which are being made in new training systems.

The exploitation of communications networks is a less certain feature of current activity. Sufficient investment in the telecommunications infrastructure to make it amenable to multimedia usage is too high to assume that universal coverage will be possible. Instead, selective and incremental infrastructure building will take place. As the new infrastructure is established on an incremental basis, the level of uptake and the revenues earned will be key considerations in any assessment of the value of extending broadband communications. It is essential for the training environment that practitioners are able to experiment with and utilise new communications systems. Experience elsewhere, particularly in Japan, suggests that training and education could become important users of advanced communications networks. However even on an experimental basis the cost may be high. The training community and the providers of advanced communications infrastructure are therefore in a quandary: as the new communications structure evolves the training community is unlikely to gain affordable access to multimedia communications without considerable discounting by the PTAs. If the PTAs adopt a policy of discounting this will represent a possible diminution of the PTAs return on investment. It might also lead to regulatory problems.

1.3. Europe in a Competition Scenario - The Internal Market

In competitor regions, the training and retraining of the adult workforce, as well as the quality of education in schools, is already a major issue. In the United States there are now frequent references to a "crisis" in adult learning. Both the United States Federal Government and the Japanese Government have recently completed wide ranging reviews of their school curricula and the results have emphasised the need for greater flexibility and autonomy in the student population. Both the USA and Japan are experimenting with, and developing considerable experience in, new learner technology including new distance learning techniques.

A number of innovative schemes, ie COMETT, EUROTECHNET, ERASMUS (EC sponsored) and other initiatives at European level, such as EADTU, SATURN, EUROPACE, EUROSTEP, have been introduced with the general aim of improving the level and access to training. However in about half the projects the development of training courses for new technology through the use of new technology can be seen. Despite the number of initiatives taken, it cannot be said that these projects comprise a training strategy for Europe.

In the context of international economic and strategic issues, the completion of the internal European market is of extreme importance. At present the Member States have neither a universal system for mutual recognition of professional training courses nor a transnational network of training services. This creates a number of labour mobility problems which must be overcome. Telematics based services are a potential solution.

The strategic aim behind the development of new learning systems is to create the conditions in which European organisations can access, when and where they need to, the necessary knowledge, expertise and skills development resources which will allow them to compete effectively in the changing economic climate of the 1990s. As a preparatory measure it is important that a European solution to human resource development is recognised as a key strategic consideration in future economic development. The rationale for a European solution hinges in part on the importance of the Internal Market. New technology may well offer the possibility of unifying training provision in the Community, thereby contributing to a more homogeneous labour market.

Nevertheless, some challenges are brought about, and have to be addressed. For example, the linguistic and cultural diversity of the Community which restricts the potential market for private sector training suppliers, and potentially inhibits their willingness to invest in costly production and distribution facilities. There is also the lack of harmonisation in copyright legislation, which deters multimedia publishers from placing new multimedia learning materials onto the European market.

The organisation of training in some Member States has traditionally been supported by public expenditure. There is now a reorientation towards support for private sector training supply. The responsibility for investment training needs to be clearly allocated between the public and private sectors. National differences make it difficult to create a European strategy.

The role of the private sector in a learning technology strategy is becoming increasingly important. Private sector organisations are already investing in experiments such as EUROPACE. The development of innovative systems such as CD-I are private sector initiatives. Because industry and commerce is now organising more on a European, indeed a global, basis the responsibility for resolving the training problem will increasingly pass from national Governments to industrial and commercial corporations. It is doubtful whether there is yet sufficient strategic concertation of public and private resources.

2. SHAPING OF CHANGE: POTENTIAL MARKET DEMAND AND PROBLEMS OF SUPPLY

New learning technologies can be assumed to have an important role in enhancing learning in the workplace, in the educational sector and in the home. However, the uptake of new multimedia learning technologies is far from assured. Cost is a major inhibiting factor especially in the years when new technologies first arrive in the market. It is also true to say that emerging technologies are not all complementary to each other. There are competing systems which have yet to identify clearly with a particular market segment.

The issue is to define, realistically, the likely pace of innovation and market uptake of different systems, in the light of critical cost factors.

The introduction of new learning technologies tends to follow a typical demand and supply curve. At the point of introduction new technologies are expensive and tend to be used by organisations with sufficient resources to invest in new techniques as a means of gaining a short term competitive advantage. As the advantage is proven, more firms invest in innovation and the cost of products declines. As costs decline, the market for a product broadens creating a further knock-on effect, reducing prices to the point where a product enters the buying range of the mass market.

In the learning domain, critical cost factors inhibiting the mass market can be identified in the production and distribution of new training services. These all bear on the development of the training market. For example, the electronic delivery of new training services can be achieved at a comparatively low unit cost (cost per learner served) if the market is sufficiently well developed. On the other hand a significant reduction in the costs of producing and distributing training materials and the receiving terminals, could bring training services within the reach of a wider market - such as the small and medium sized enterprise and the home learner.

Much of the infrastructure for the reception of training material in the home and in business already exists in the form of TV sets, video cassette recorders and TV reception equipment. PCs are increasingly penetrating the home and small business markets. However, new products with far greater capabilities and which are well suited to educational use are now coming on to the market. In particular CD-I, DVI and multimedia workstations offer the learner the ability to interact with learning materials. It is important that these products are adopted by trainers, and that they fall within the buying range of small businesses and home users.

In order to maximise the benefits of R & D it is essential to identify the critical cost factors. These appear to be: the cost of powerful multimedia workstations for authoring and simulation, the cost of multimedia production and the cost of telecommunications transmission. However these factors and possible cost saving need to be better understood.

Digitisation of the telecommunications infrastructure and the introduction of ISDN present the possibility of more extensive interaction 'at a distance'. Costs, however are high for the end user. Some form of educational discounting scheme is necessary.

3. LEARNING TECHNOLOGY PEDAGOGICS

Some specific pedagogic issues have been identified as the means to ensure the effective use of ALT. They are described in Volume II of this report.

3.1. Tutoring and Supporting the Learning Process

Successful applications of distance/open learning depend on the availability of sufficient and effective learning support to allow the learners to independently use and harness learning environments and the learning process. The support should be self-directing according to the individual learners' profiles and needs and must be embedded within the system. Cognitive and pedagogic guide-lines in ALT use, either in stand-alone systems or human tutoring at a distance, have to be incrementally developed. Stand-alone systems should be more adaptable, allowing prediction and mixed-initiative. More research is needed in knowledge representation and in learners' misconceptions. Help systems should be more intelligent giving individual advice and even coaching to the learners.

3.2. Monitoring and Management of the Learning Process

An information management system is an essential tool for certain actors in the system, eg tutors. It can provide the information needed to make decisions, it can advise which course has to be followed and advise learners and tutors on didactic strategies, it can deliver reports and it can facilitate accreditation and certification of courses.

3.3. Modelling the Learner or Trainee

Learner modelling concerns the 'model' of the learner that is present in the system, and that can be used to adapt the appearance of the systems' actions to the user. This will help the learner by making the course more personalised.

In order to select appropriate learning/instructional strategies which are best suited and adapted to the needs of each individual learner, it is necessary to have information on relevant learner characteristics in the form of a learner model.

3.4. Didactic Strategies

The term didactic strategy refers to the choice of instructional methods and media designed to bring about effective learning. This includes not only the 'content' of the course but also decisions about learner support, assessment and choice of media. The development of IT based tools, allowing support in a flexible manner and diverse tuition systems, should be carried out with special emphasis on 'learning-by-doing' strategies.

3.5. Exploratory Scenarios

Exploratory and simulation based systems are an alternative to traditional tutoring systems. They offer a stimulating environment which can be explored by the learner. Interaction with a simulation or any other exploratory system is expected to augment the learner's experiences and, hence, his or her level of knowledge. Learning-by-doing is one of the most promising didactic strategies currently being promoted by the usage of ALT.

Nevertheless, more research is required on the integration of different tools conveying diverse didactic strategies, to test their effectiveness and assess their benefits.

3.6. Collaborative Learning

Collaborative learning at a distance is one way to overcome the isolated situation of the distant learner. It is necessary to identify different needs and patterns and to undertake tests of the most adequate technology available to allow different categories of users to work cooperatively in different settings.

3.7. Psychological, Motivational and Human Factors

The basic approach of human factors research in flexible and distance learning is examination of the relationship between user characteristics and pedagogic demand with regard to what technology has to offer. In particular it is the user characteristics versus technological capability relationship (also called human-machine interaction) which presents the difficulty in developing appropriate technological specifications. The choices to be made between the various Advanced Leaning Technology on offer for satisfying user characteristics/pedagogic demand needs are comparatively easy but only if the user characteristics/technological capability relationship is determined.

It is necessary to complete the human-machine interaction layer and, on that basis, to develop intelligent interfaces including some features of adaptability to different learners' groups.

3.8. Learning Technology Cost and Effectiveness

Demonstrating the effectiveness of learning technology is an important issue for the advance of learning technology. It depends on the suitability and adequacy of the media and learning strategies to the topic and to the learner patterns. Learning materials must be flexible enough to allow self-pacing, access to complementary resources, choice of level of difficulty and give appropriate guidance within pedagogical resources.

Some specific requirements identified deal with cataloguing case studies, identification of media relevant to specific aims and the development of a framework for future targeted experiments. These pilots should be large-scale in order to assess the results in real situations.

The reduction in costs of software and equipment by means of portable and interoperable standard systems is a key issue for the acceptance of learning technologies.

3.9. Evaluation of Processes, Skills and Resources

New technologies must improve the efficiency of the learning process. They must also facilitate transfer of skills, possibly taking into account the learners' pace and style, and technological potential.

Evaluation of the learning process itself is a key issue in so far as it allows the adaptation to style, pace and presentation. Keeping track of the learner reactions is one of the aspects of tutoring and monitoring systems, and broad evaluation of processes must be carried out in order to improve the interactivity and user friendliness of all systems. A methodology to carry out a systematic evaluation of courseware has to be developed in parallel.

3.10. Design Methodologies

One of the critical factors in the success of open and distance learning courses is courseware design. New information technology can ease the uptake of distance and open learning methods in different areas by providing tools for the planning process and for the actual design of course materials and learning environments, allowing a multi-strategy approach. It must also cater for the whole design process and not only for the so called authoring phase.

4. LEARNING TECHNOLOGIES

A series of technological issues have been identified and are developed in Part 4 of Volume II of the document. They deal with the current technology available for learning and the chief domains for application.

4.1. Portability, Interoperability and Standardisation

This field includes systems standards (dedicated configurations for learning applications, operating systems and peripherals), storage and information representation, telecommunications, man-machine interaction and application standards.

Portability, interoperability and standardisation are prerequisites for an effective and economic open learning market. Standardisation should be both technology and market driven and based on existing and emerging standards and conventions.

4.2. Learning Configurations

Flexible and distance learning can take place in widely varying settings. A rough distinction can be made between home company and institution.

Each setting allows for specific technological options and sets specific requirements in terms of cost, equipment, support etc.

Advances in learning technology and price developments for IT&T in general allow for an increase of learning opportunities in each setting.

4.3. Learning Facilities

The quality of flexible and distance learning not only depends on functionalities of applied systems configurations and the availability of portable and quality learning material, but also on the availability of a software environment that enables or facilitates learning. Such an environment should provide facilities for support, communications and dedicated learning tools.

4.4. Design and Production Systems

The establishment of a European market for flexible and distance learning depends strongly on the quality and quantity of available learning materials. Regarding the costs and complexity of learning material development professional and flexible (in terms of learning approaches, media, portability and transferability) development systems and dedicated tools covering the range of activities (from analysis to distribution) are required.

4.5. Communications

For flexible and distance learning not only communications between learners, tutors and producers, but also the acquisition, storage, processing, retrieval and representation of information and learning materials are becoming increasingly important. In particular the creation of a European market will be based on cost effective communications services.

It is not necessary to develop new networks for educational purposes. Nevertheless, training services raise some specific requirements, such as multi-language user-friendly interfaces, standard protocols allowing on-line user guidance, accounting and accreditation.

Applications should be based on existing and emerging communications facilities, such as wide area networks and satellites. ISDN and future IBC systems will offer possibilities for integration of services, which should be fully exploited for distance education.

4.6. Information Environments

Flexible and distance learning will more and more depend on the availability of information and learning material resources, such as centralised or generic multimedia databases and on-line access to distributed resources.

The development of learning materials will be increasingly based on the incorporation and transfer of existing materials, while learning will depend more on the direct access of distributed information and learning material resources.

Therefore, some specific facilities have been identified for training applications, such as navigation systems or AI based tools to access resources, which must be part of any value added telecommunications service for education.

4.7. Training Servers

Extensive flexible and distance learning requires integrated systems and facilities enabling multiple user interaction and local or remote communications between human actors and information resources.

These systems are based on hosts connected with on-line terminals which provide specific services based on training and education requirements for different actors (learner, human tutor, monitor or administrator).

4.8. Applications

If learning technologies are to be exploited, the former technological issues are not enough. An effort is needed to harness the technologies to specific learning purposes. Therefore specific target groups' needs have to be identified and then met by specifically adapted technology. Such groups considered in this report include:

- Disabled people because of the evident need to meet a range of specific problems.
- Language learning, because of the intrinsic importance of this domain and because the requirements of interactivity are a chief concern.
- Collaborative learning, because this requires a specific usage of telecommunications to achieve success.
- Exploratory learning, simulation and modelling, because this area nicely complements a sound pedagogic approach and it is suitable for pilot testing applications based on specific advanced technologies, simulations and Artificial Intelligence based tools.

All the dedicated tools for any specific application should be tailored to the target audiences and/or to the specific methodologies they should convey and they should also be field tested. A prior analysis of needs and technology available to meet them should be carried out.

5. POLICY AND PLANNING FOR IMPLEMENTATION

The pedagogic and technological topics identified need to be complemented by policy measures in order to overcome existing barriers to progress. Any future large-scale implementation of flexible and distance learning services, based on advanced technology, needs to take into account a range of different scenarios.

5.1. Regulatory Framework

The various regulations which govern the market conditions and use of ALT can either inhibit or encourage their uptake. The current regulatory regime, in some important aspects, is more likely to inhibit than promote ALT.

The areas in which regulations are perhaps most critical are: copyright to protect the interest of multimedia and software producers; legislation which confers monopoly rights over the provision of telecommunications services and broadcasting regulations.

5.2. Norms and Standards

Learning technology components must be integrated in a standardised context which guarantees interoperability and enhancement of market penetration. Market integration, technical integration and harmonisation is only possible through the identification of appropriate interoperable standards. They are a pre-requisite for an effective and economic open learning market. Without endorsed standards, markets are unlikely to develop. Standards bodies (like the International Organisation for Standardisation) need to be approached so as to include in their activities the ALT, in order to stimulate markets and reduce risks to suppliers and users.

Standardisation should be both technology and market driven and assist European industrial and commercial organisations to improve their economic performance through the use of Advanced Learning Technologies.

Central to the learning and training market is the user with his/her specific learning and training needs, whether the user be an individual learner, a training purchaser, a training deliverer or a courseware author. Users must be involved in the process of defining a learning infrastructure in order that maximum benefits are derived for both the demand and supply sides of the market.

5.3. Editorial Scenarios

Most distance or remote learning is still largely based on traditional printed materials. However, there is an increased demand and concern for new products, once the compatibility problems are solved.

In the future, users of learning materials, such as corporate training managers or university training services, will 'remotely' consult descriptions of learning materials. Expert resource centres will remotely 'serve' information and educational materials on different topics. Users will download electronic versions of the bibliographies or the draft texts they are interested in. Corporations or teaching institutions will have the materials tested by their students and will improve them locally through their desktop publishing services. They will remotely access demonstrations of available videos and educational software packages.

In order to pave the way to general realisation of these trends become real, research is needed in some areas, such as the definition of high quality standards in production, in distribution systems and some accompanying measures which are required.

5.4. Technological Scenarios

All previous attempts to develop equipment for the sole use of education have failed. Although the education market is a fairly big one, it is also very price sensitive. The present and the future education workstation will be solely based on 'off the shelf products'. Any valid scenario should concentrate on technologies that are likely to generate consumer products.

The focus will be put on the technologies that are going to influence the development of new advanced learning systems in the future:
- the operating systems, a basic concern to any IT based product,
- storage devices, because of the availability of new means of storage and distribution, learning material will have a long term impact on the overall scenario of ALT products.

5.5. Telecommunications Scenarios

Developments in the field of Telecommunications have resulted in an increasing improvement in terms of capacity of information transmittable from one point to another point, either as data, voice or images.

The high performance tools will have a great impact on training applications, but the success of advanced telecommunications in training is not only a question of technology but it depends also on social, political and economic factors.

With the introduction of optical fibres and the development of fast switching, the cost of data transmission is now falling faster than the cost of data processing.

5.6. Infrastructures

There is no point in running any R&D programme unless consideration is made of how the exploitation of results can be achieved. An infrastructure allowing the real uptake of services through their implementation is necessary. A set of key issues has, therefore, been identified in order to determine the networks and centres required for a successful uptake of services.

5.6.1. Local Training Centres

Local open access centres allowing public access to information and telecommunication facilities for training and education are considered central to any implementation strategy.

Although education and training are increasingly individualised, there is a strong need, at a local/regional and/or national level, for places which will provide general non individualised training services and technical expertise.

5.6.2. Setting Up Mobility Schemes, Research Networks and Centres of Excellence

Some other basic infrastructures are needed if a an R&D application programme is to succeed on a European scale. Thus it is necessary to identify and network centres of excellence in specific areas of research in ALT, and supporting technology transfer schemes.

5.6.3. Administrative Facilities

One of the main issues in distance learning is the ability of system to award accreditation and certification. This requires a minimum level of conventions and coordination in the facilities provided on the network, and in parallel, there is a need for a network of administrative facilities and human support.

5.6.4. Distribution

An adequate distribution network of learning materials is a major issue if the end-user is to have access to products. Distribution has to deal with: information on products and links between those products and the related curricula; training and support of the clients of the commercial/public human/technical network; maintenance of the products delivered through networks; private/public infrastructure of learning materials delivery; technical infrastructure for local delivery, pricing or tariffing of broadcast services; adequate protection to avoid service pirating through networks.

Human and technical networks supporting the physical delivery, teleloading or broadcast of learning material are key issues for European competitiveness.

5.7. Evolutionary Strategies

Networked training offers the long term possibility of significant cost savings for transnational training. The successful application of the technology depends on a long term commitment to network infrastructure services - advising on standards, protocols and equipment, technological evolution, tariffs etc. This has to be coordinated across Member States.

A precondition has been identified to achieve an integrated service of distance learning at European level: a new concept of training emphasising aspects like flexibility, rapid access to expertise, which cannot any longer be regarded as a static achievement.

The proposal for a new services infrastructure, the Electronic University, has been developed to satisfy the following related requirements: to create conditions in which the demand for rapid access to skills and expertise can be met, to create an experimental environment to pilot new techniques, to enable access to training and retraining to adults in work and to achieve all these objectives in a cost-effective manner by realising economies of scale.

The chief aspects of such a service are: distributed courseware production, computer conferencing and the use of interactive electronic networks.

The stages anticipated as necessary for implementation are: the establishing of a consensus on requirements and specifications amongst users and the definition of possible structures and the services which they might offer.

These services could include: definition of standards, negotiation of favourable telecommunications tariffs and installation rates, international exchange of experiences, interconnecting existing services, provide access to expertise and mediabases, a testbed for distance learning experiments and the management of the evolution to new advanced services in the future.

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